

What is claimed is:

1. A purified  $\beta$ 4 acetylgalactosaminyl transferase which is substantially free of other proteins.

2. The purified  $\beta$ 4 acetylgalactosaminyl transferase of claim 1 having SEQ ID NO: 1.

3. A purified  $\beta$ 4 acetylgalactosaminyl transferase which is substantially free of other proteins, comprising an amino acid sequence which has at least about 90% identity with SEQ ID NO: 1, and which has enzymatic activity of a  $\beta$ 4 acetylgalactosaminyl transferase.

4. A recombinant  $\beta$ 4 acetylgalactosaminyl transferase comprising SEQ ID NO: 1.

5. An isolated polynucleotide which encodes a protein having  $\beta$ 4 acetylgalactosaminyl transferase activity and which is selected from the group consisting of:

(A) a polynucleotide which selected from the group consisting of SEQ ID NO:2 and an expressible coding sequence of SEQ ID NO:2;

(B) a polynucleotide which differs in nucleotide sequence from the polynucleotides of (A) above due to degeneracy of the genetic code and which encodes a protein having  $\beta$ 4 acetylgalactosaminyl transferase activity; and

(C) a polynucleotide which differs in nucleotide sequence from the polynucleotides of (A) or (B) in that said polynucleotide lacks a nucleotide sequence which encodes a transmembrane domain wherein the  $\beta$ 4 acetylgalactosaminyl transferase encoded is soluble.

6. The polynucleotide of claim 5 wherein the polynucleotide is DNA.

7. A vector containing the polynucleotide of claim 5.

8. A host cell transformed or transfected with the vector of claim 7.

9. A process for producing a protein having  $\beta$ 4 acetylgalactosaminyl transferase activity comprising the steps of:

culturing the host cell of claim 8 thereby expressing the  $\beta$ 4

acetylgalactosaminyl transferase ; and

purifying the  $\beta$ 4 acetylgalactosaminyl transferase from the cultured host cell.

10. The process of claim 9 wherein the protein having  $\beta$ 4 acetylgalactosaminyl transferase activity is soluble.

11. The host cell of claim 8 wherein the polynucleotide is operatively associated with an expression control sequence contained in said vector.

12. The host cell of claim 8 transformed or transfected with an expressible polynucleotide encoding a peptide or polypeptide requiring post-translational formation of an LDN structure thereon.

13. An isolated polynucleotide which encodes a protein having  $\beta$ 4GalNAcT activity and which is selected from the group consisting of:

(A) a polynucleotide which hybridizes with a nucleic acid selected from the group consisting of SEQ ID NO:2 or an expressible coding sequence thereof;

(B) a polynucleotide which hybridizes with a nucleic acid which differs in nucleotide sequence from the isolated polynucleotides of (A) above due to degeneracy of the genetic code and which encodes a protein having  $\beta$ 4GalNAcT activity; and

wherein the polynucleotides of (A) and (B) hybridize under stringency conditions comprising prehybridization and

hybridization at 68°C followed by washing twice with two x SSC, 0.1% SDS at 22°C, and washing twice with 0.2 x SSC, 0.1% SDS at 22°C; or prehybridization and hybridization at 42°C in 5 x SSPE, 0.3% SDS, 200 ug/ml sheared and denatured salmon sperm DNA, and 25% formamide, or 35% formamide, or 50% formamide, and washing with 2 x SSC, 0.2% SDS at 50°C.

14. The polynucleotide of claim 1 wherein the polynucleotide is DNA.

15. A vector containing the polynucleotide of claim 13.

16. A host cell comprising the vector of claim 15.

17. A method for producing a protein or peptide having a GalNAc $\beta$ 1, 4 GlcNAc structure thereon, comprising the steps of:

providing a host cell having an expressible polynucleotide encoding a peptide or polypeptide requiring a GalNAc $\beta$ 1,4GlcNAc structure and transformed or transfected with the vector comprising a polynucleotide encoding a  $\beta$ 4GalNAcT;

expressing in the host cell the  $\beta$ 4GalNAcT and the protein or peptide requiring the GalNAc $\beta$ 1,4 GlcNAc structure thereon thereby forming a glycosylated protein or peptide having the GalNAc $\beta$ 1, 4GlcNAc structure; and  
purifying the protein or peptide having the GalNAc $\beta$ 1,4GlcNAc structure thereon.

18. The method of claim 17 wherein the polynucleotide comprises SEQ ID NO: 2 or an expressible coding sequence thereof.

19. The method of claim 17 wherein the  $\beta$ 4GalNAcT comprises SEQ ID NO: 1 or a variant thereof having  $\beta$ 4GalNAcT activity. 20. An in vitro method of producing a protein or peptide having a GalNAc  $\beta$ 1, 4GlcNAc structure thereon, comprising the steps of:

providing a protein or peptide requiring a GalNAc $\beta$ 1,4GlcNAc structure;

providing a protein having  $\beta$ 4GalNAcT activity;

providing a GalNAc donor; and

combining the protein or peptide requiring the GalNAc  $\beta$ 1,4GlcNAc with the

protein having  $\beta$ 4GalNAcT activity, and with the GalNAc donor thereby

forming a protein or peptide with the GalNAc  $\beta$ 1,4 GlcNAc structure.

21. A monoclonal antibody raised against a  $\beta$ 4GalNAcT protein or peptide.
22. The monoclonal antibody of claim 21 raised against SEQ ID NO: 1 or an antigenic portion thereof, wherein the monoclonal antibody binds specifically to SEQ ID NO: 1.